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Supplementary Information for

Critical slowing down suggests that the western Greenland ice sheet is close to a tipping point

Niklas Boers, Martin Rypdal

Niklas Boers
E-mail: boers@pik-potsdam.de

This PDF file includes:

Figs. S1 to S6 (not allowed for Brief Reports)
SI References

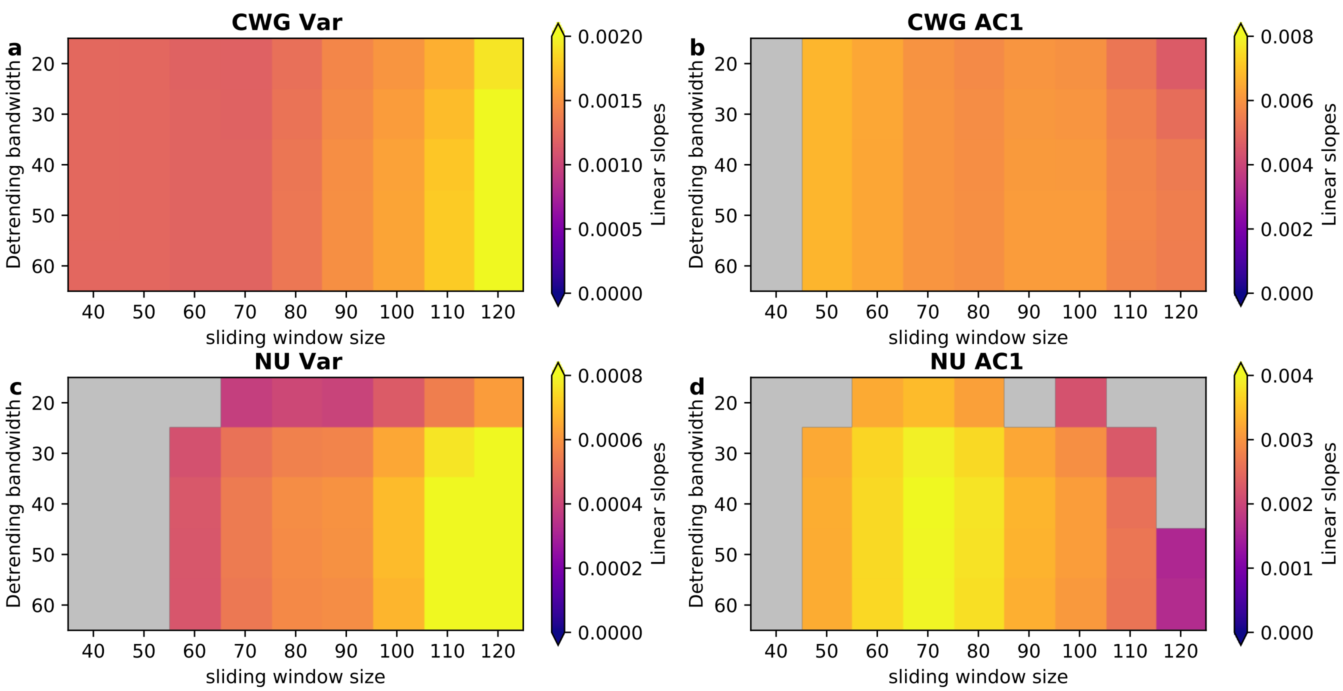

Fig. S1. Estimated linear slopes of the Variance and AC1 for the melt rates from the CWG stack and NU core, as a function of the bandwidth σ used for nonlinearly de-trending the melt rate time series, and of the size of the sliding windows used to estimate the Variance and AC1. Non-significant slopes (with $p >= 0.05$) according to our phase surrogate test (see Methods) are shown in grey.

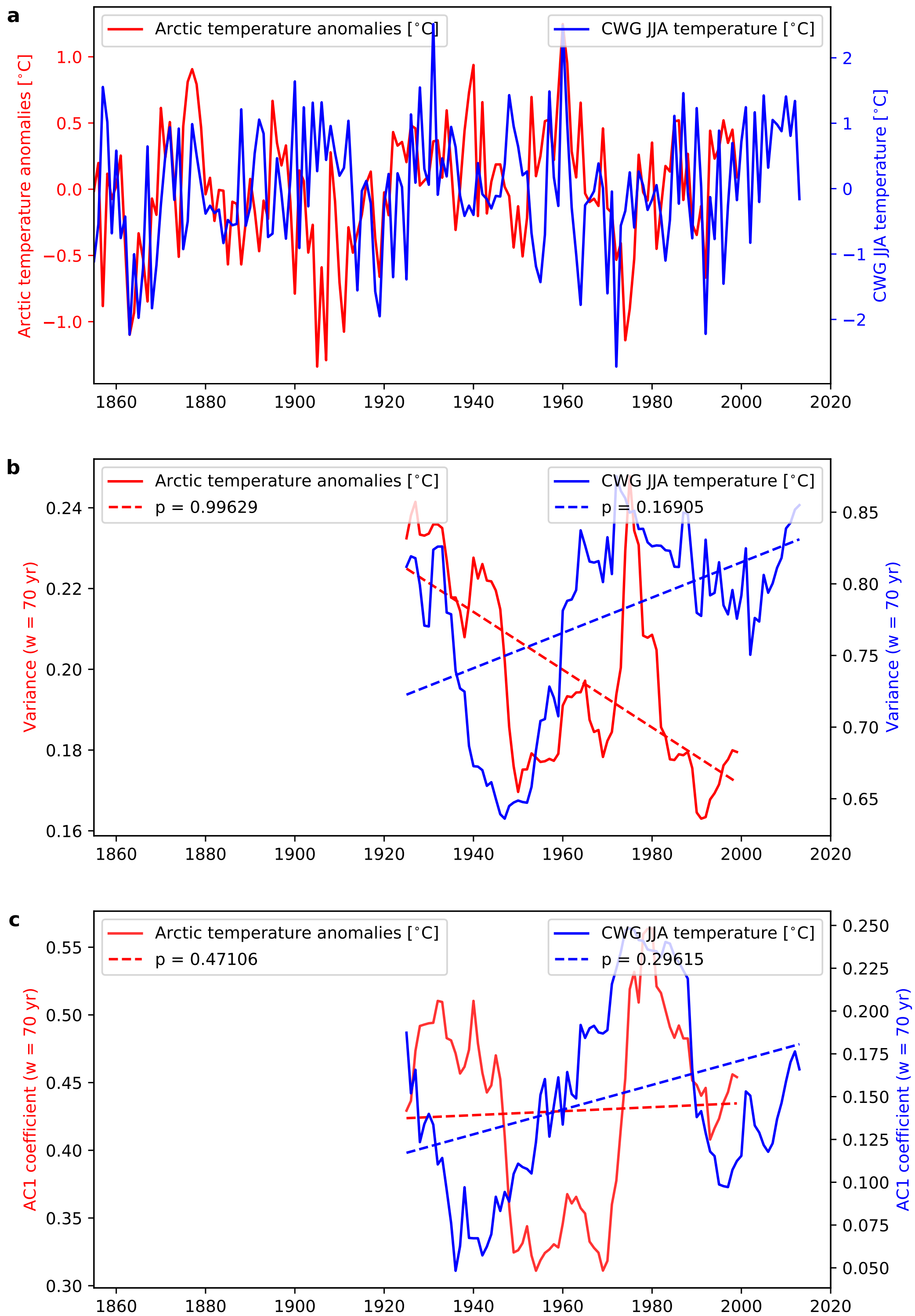

Fig. S2. **a** Arctic temperature anomalies (1) (red) and summer sea-level temperatures from the Ilulissat station in CWG (2) (blue), nonlinearly de-trended using a Gaussian filter with bandwidth $\sigma = 30$ yr. **b** The variance of de-trended arctic temperature anomalies (red) and the de-trended CWG summer sea-level temperature record (blue). **c** The lag-one autocorrelation (AC1) of the de-trended arctic temperature anomalies (red) and the de-trended CWG summer sea-level temperature record (blue). A sliding window with size $W = 70$ yr was used to estimate the variance and AC1 evolution. No significant increase can be observed in the EWS indicators for these temperature records, indicating that the significant increases we find for the EWS indicators applied to the CWG and NU melt rates is not caused by corresponding changes in the driving temperatures.

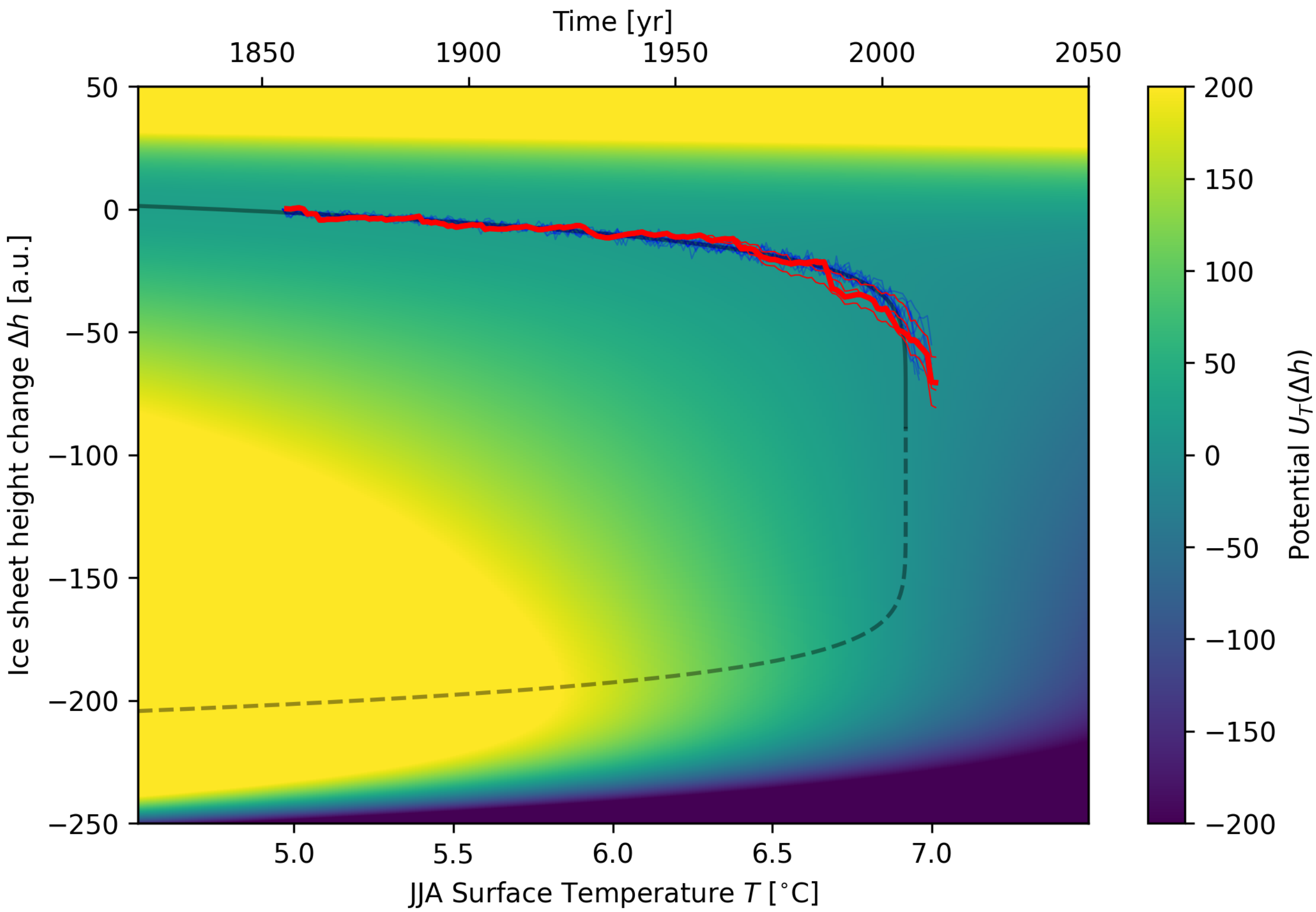

Fig. S3. Two-dimensional version of Fig. 2; here, the potential $U_T(\Delta h)$ (in arbitrary units) is represented by colors. The bold red line shows the reconstructed height change based on the long-term melt rate estimates from (3), the thin red lines represent the different model simulations from the same study, and the thin blue lines show the simulations of the conceptual model of the melt-elevation feedback. The solid grey line indicates the theoretical stable equilibrium state of the conceptual model, which is closely followed by both the reconstructions and model simulations. The dashed grey line represents the corresponding unstable state.

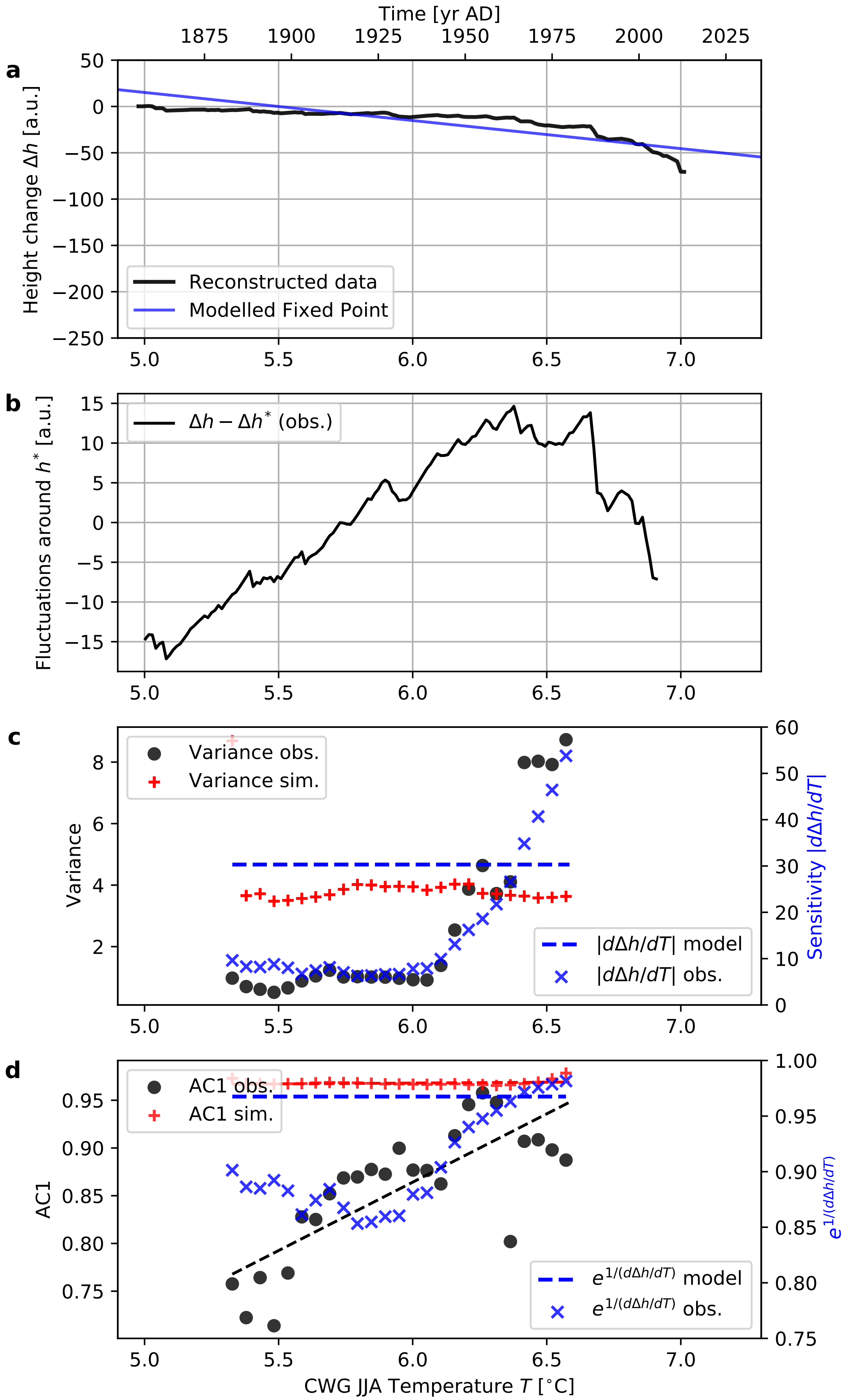

Fig. S4. Same as Fig. 3 of the main text, but for a linear model of the ice sheet height, i.e., using an exponent $m = 1$ instead of $m = 8$ in Eq. (1) of the main text. Note that in this case, the model simulations are inconsistent with the observations in terms of all indicators considered here.

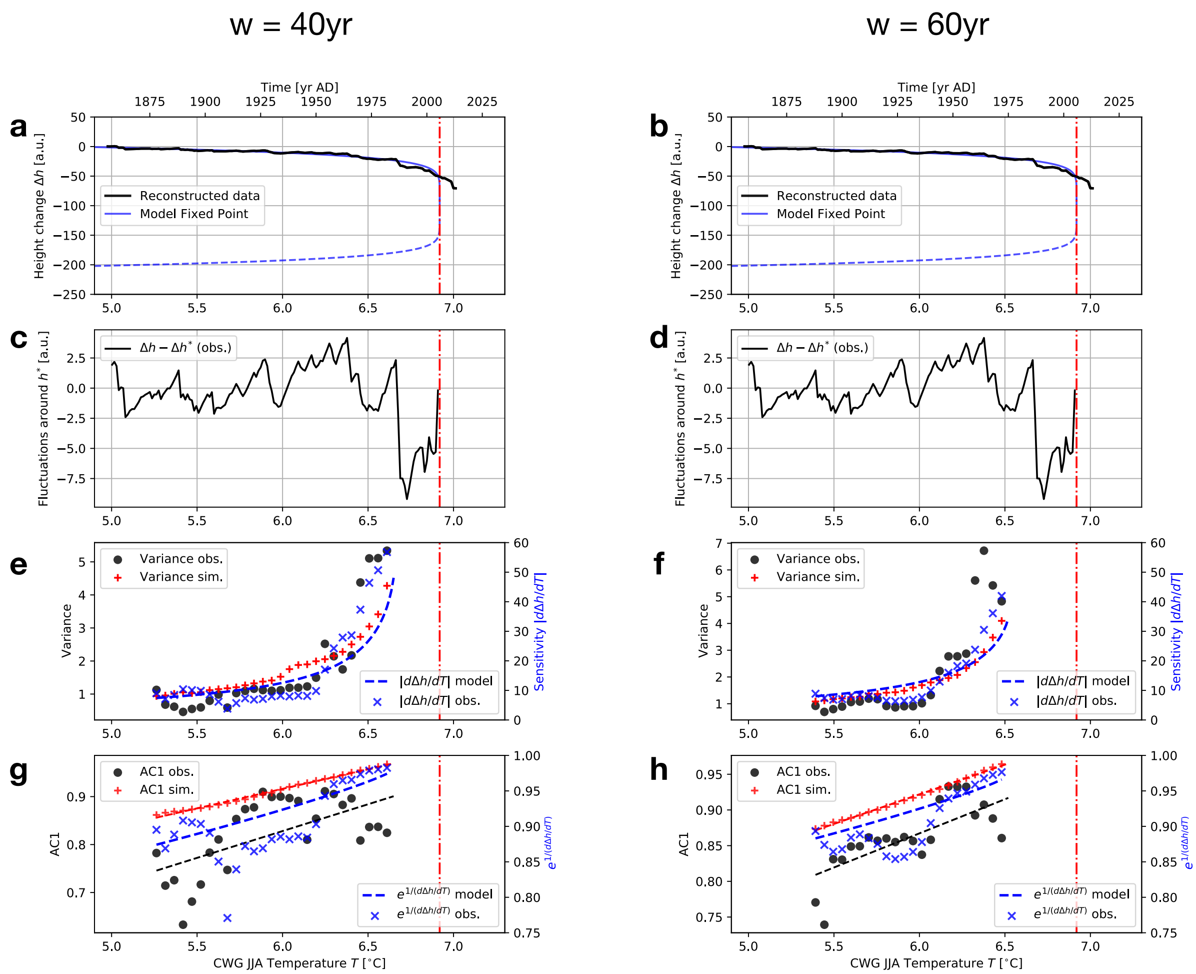

Fig. S5. $\mathbf{a}$, $\mathbf{c}$, $\mathbf{e}$, $\mathbf{g}$ Same as Fig. 3 in the main text, but using a sliding window size of $w = 40$ data points. $\mathbf{b}$, $\mathbf{d}$, $\mathbf{f}$, $\mathbf{h}$ Same as Fig. 3 in the main text, but using a sliding window size of $w = 60$ data points. For the results presented in Fig. 3, $w = 50$ data points was used.

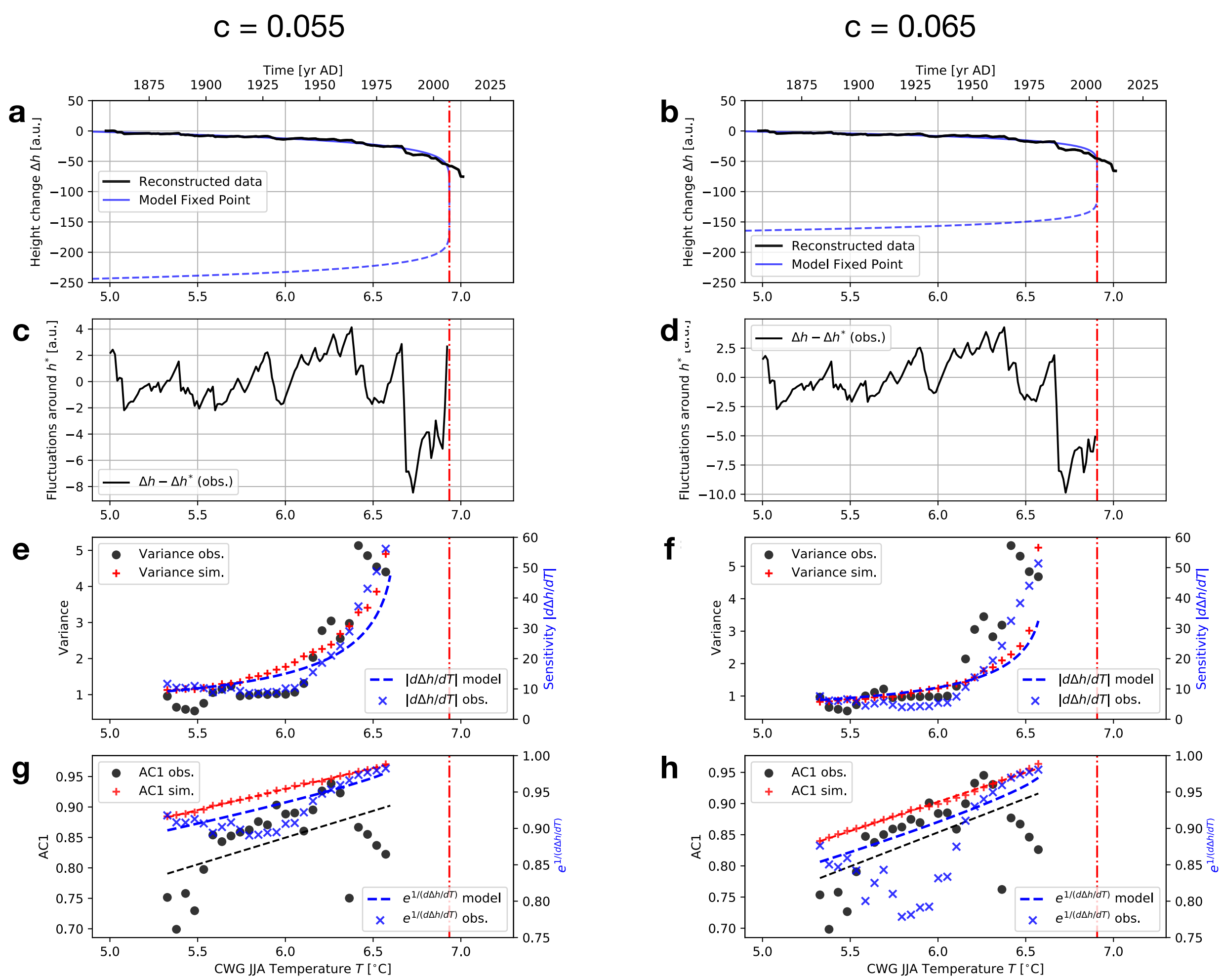

Fig. S6. $\mathbf{a, c, e}$ Same as Fig. 3 in the main text, but using an a proportionality constant of $c = 0.055$ for inferring accumulation rates from temperature when reconstructing the GrIS height change Δh from the CWG stack melt data. $\mathbf{b, d, f, h}$ Same as Fig. 3 in the main text, but using an a proportionality constant of $c = 0.065$ for inferring accumulation rates from temperature when reconstructing the GrIS height change Δh from the CWG stack melt data. For the results presented in Fig. 3, $c = 0.06$ was used.

References

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2. J Cappelen, BM Vinther, SW Greenland temperature data 1784-2013, (Danish Meteorological Institute), Technical report (2014).
3. LD Trusel, et al., Nonlinear rise in Greenland runoff in response to post-industrial Arctic warming. *Nature* **564**, 104–108 (2018).